

Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

AGROS. 52.

U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 102.

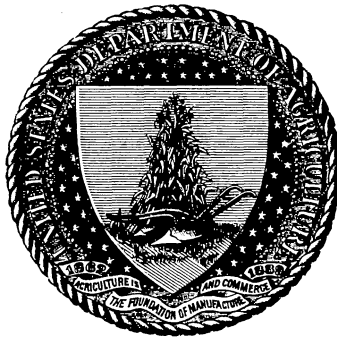
SOUTHERN FORAGE PLANTS.

COMPILED FROM THE PUBLICATIONS OF THE DIVISION OF AGROSTOLOGY

BY

F. LAMSON-SCRIBNER,

Agrostologist.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1899.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF AGROSTOLOGY,

Washington, D. C., June 15, 1899.

SIR: I have the honor to transmit herewith, and to recommend for publication as a Farmers' Bulletin, a paper on the forage plants of the South compiled from various publications of the Division.

The grazing and forage problems in the South are of great importance. Keen competition is compelling the adoption of a more diversified system of agriculture than has existed in the past. Fine cattle and good milk and butter are more profitable than cotton, and there is an increasing demand for good hay and pasture grasses and other forage crops. The climate is excellent for the growth of many kinds of grasses, and the soils for the most part are good or are readily susceptible of cultivation and improvement.

There are about 400 species of grasses occurring in the Southern States, and there are wide areas in each of these States which may be profitably devoted to meadows and pastures. The investigation of those grasses which are most likely to succeed, and which will at the same time be best suited to meet the needs of the stock raisers and dairymen, has been made a prominent feature in the work of the Division of Agrostology for several years, particular attention having been given to noting the abundance and value of the native forage plants and the possible methods to be employed in maintaining or improving the existing pastures and forage supplies.

It has been clearly demonstrated that the soils and climate of the Gulf States are favorable to the production of an abundance of forage, and that the quality of Southern-grown hay is fully equal to that produced in the North or West.

Respectfully,

F. LAMSON-SCRIBNER,
Agrostologist.

Hon. JAMES WILSON,
Secretary of Agriculture.

CONTENTS.

	Page.
Introduction.....	5
Formation and care of pastures	6
Preparation of the land.....	6
Time of sowing.....	6
Application of fertilizers.....	6
Soiling and fodder crops	8
The more important hay and pasture plants	8
Grasses	8
Barnyard grass	8
Bermuda grass.....	9
Big Blue-stem	11
Carpet grass.....	11
Colorado grass.....	12
Crab grass.....	12
Foxtail millets.....	13
Guinea grass.....	15
Johnson grass	16
Kafir corn	17
Kentucky blue grass	17
Large water grass	18
Orchard grass.....	18
Para grass	18
Redtop	18
Rescue grass.....	19
Rye grasses.....	20
Smooth brome	21
Sorghum	21
Southern canary grass	25
St. Augustine grass	25
Tall fescue.....	25
Tall oat grass.....	26
Texas blue grass.....	26
Teosinte.....	27
Leguminous forage plants.....	29
Alfalfa	30
Alsike clover	31
Beggar weed	31
Bird's-foot clover	33
Bur clover.....	33
Cowpea.....	33
Crimson clover	37
Japan clover.....	38
Red clover	38
Soy bean	40

The more important hay and pasture plants—Continued.		Page.
Leguminous forage plants—Continued.		
Sulla		40
Sweet clover		40
White clover		40
Yellow lupine		41
Velvet bean		41
Hairy vetch		43
Winter vetch		44
Miscellaneous forage plants		45
Artichoke		45
Cassava		46
Chinese yam		46
Chufa		46
Mexican clover		46
Peanut		46
Adaptation of forage plants to soils		47

ILLUSTRATIONS.

	Page.
FIG. 1. Bermuda grass	9
2. Carpet grass	12
3. Rescue grass	19
4. Italian rye grass	20
5. Tall oat grass	26
6. Texas blue grass	27
7. Teosinte	28
8. Alfalfa	29
9. Florida beggar weed	31
10. Cowpea	34
11. Japan clover	38
12. Soy bean	39
13. Velvet bean	41
14. Hairy vetch	44

SOUTHERN FORAGE PLANTS.

INTRODUCTION.

The soil, climate, and conditions of the Southern States are so different from those of the North that different species of plants, as well as different methods of culture and treatment, are necessary to success in the making of meadows or pastures. The soil, although almost wholly of sedimentary formation, is exceedingly variable in character. Much of it has had nearly all of its vegetable matter exhausted by continuous cultivation in cotton. In many sections extreme care is necessary to prevent the washing of hillsides. Severe freezes are unknown, so that many of the more hardy plants continue their growth during the entire winter. On the approach of hot weather these plants disappear, and their places are filled by a rank summer growth of plants, many of which are too coarse and unpalatable to be of value for either hay or pasture. Although the growing season is almost continuous for some species, there are none which will make a vigorous growth throughout the year, so that permanent meadows and pastures can be made only with mixtures of several species which make their growth at different seasons.

Sufficient hay for home consumption may be gathered on almost any plantation without expense, except for the harvesting, but such crops are uncertain in amount, are usually inferior in quality, and are rarely such as will assist in preparing the soil for future crops. A good hay plant must not be too rank in its growth, or its stems will be coarse and woody; it must have a large proportion of leaves, which are the most edible parts of the plant; it should be easily cured when made into hay, and it must be nutritious, easily digested, and palatable. If wanted for a permanent meadow, the plant must be a perennial. As the true grasses are of but little value as fertilizers, it is important that, where the crop is to be grown as a part of a rotation, at least one of the species used in any mixture should be a leguminous plant; if the forage crop is to be grown one season only, leguminous plants are always to be preferred.

FORMATION AND CARE OF PASTURES.

PREPARATION OF THE LAND.

The ground should be well plowed only a few days before the seed is to be sown, and then harrowed until the surface is thoroughly pulverized and smoothed. If hard and full of clods, a disk harrow is the best thing for pulverizing the soil, and it should be used as soon as possible after the plowing is done before the clods have time to bake. The last harrowing should be done with a "Thomas" harrow, or one similar, in order to leave the surface as smooth as possible.

Small and heavy seeds, like clover, can be sown evenly with a "wheelbarrow seeder," of which there are several kinds in the market; but for sowing coarser seeds, like Johnson grass, or chaffy seeds, like those of orchard grass, there is no machine which is satisfactory, and such seeds may be sown by hand. Light and heavy seeds should always be sown separately, as it is practically impossible to keep them evenly mixed, and in sowing by hand the heavy seeds will be thrown so much farther than the light that the field will be streaked and irregular. When the sowing is done by hand it is best to go over the field twice, using half of the seed each time and making the second sowing at right angles to the first.

For covering the seeds a heavy roller is preferable to any other implement, as it covers them more thoroughly and presses the soil about them so firmly that fewer are lost by rains and drought. If a roller is not to be had, a light smoothing harrow or even a brush may be used, but a heavy harrow should never be used except for covering very coarse seeds. When the ground is in good condition, freshly harrowed, and loose, and the seeds can be sowed just before a rain, covering is scarcely necessary, and may be omitted altogether in preference to using a heavy harrow.

TIME OF SOWING.

In the South nearly all perennial grasses and clovers will do better if sowed in August or September than at any other time, as they then become well established before the winter frosts, and are ready to make such a vigorous growth early in the spring that they will keep down the weeds and volunteer grasses which so often choke out the spring sowings. Some of the more hardy species will do well if sown as late as October or November, though even for these the earlier sowing is preferable. If the land has been occupied by other crops, so that fall sowing is not practicable, the work should be done as early in the spring as possible, so that the young plants may become well rooted before the summer drought. It is seldom advisable to sow with grain.

APPLICATION OF FERTILIZERS.

No satisfactory crops of hay can be made to grow on soils too exhausted or too barren to produce fair crops of corn or cotton, and fertilizers are as necessary and as profitable for the hay field as else-

where. The use of fertilizers is more important for meadows than for pastures, from the fact that droppings from the stock will in a great measure compensate for the material carried away; but when pastures have been used so long that the ground has become hard and the more tender plants have been killed out by trampling and close grazing, it will pay well to plow, fertilize, and reseed the ground.

Stable manure and cotton seed are the best fertilizers for plowing under before the seed is planted, and a liberal application of these will be all that is needed for two or three years, but on permanent meadows top-dressing must finally be employed to keep them in good condition. It is seldom necessary to use phosphoric acid on soils containing even a moderate proportion of lime, but all the true grasses are heavy consumers of potash and nitrogen, both of which it will pay to supply in liberal quantities. For ordinary soils 50 pounds of potash per acre is a liberal annual application, and this may be secured by using 400 pounds of kainit, 250 of cotton-hull ashes, or 100 of muriate of potash. Estimating the potash at the usual rate of 5 cents per pound, the relative value of these fertilizers per ton is as follows: Kainit, \$12; cotton-hull ashes, \$20, and muriate of potash, \$50; but as market prices are quite variable, the selection of the one for use will depend on their local cost. For soils which are deficient in lime, and where phosphoric acid is needed, the cotton-hull ashes have an additional value of about \$9 per ton on account of the phosphoric acid which they contain, and for such soils these ashes are usually the cheapest fertilizer.

When phosphoric acid alone is needed, it may be purchased most cheaply in the form of acid phosphate. The cheapest form in which nitrogen can be purchased is as nitrate of soda or as cotton-seed meal, the former having about double the amount of nitrogen contained in the latter. The meal contains approximately 7 per cent of nitrogen, 3 of phosphoric acid, and 2 of potash, which makes it practically a complete fertilizer. It is also one of the best materials for use as a top-dressing on grass lands.

It apparently makes little difference when phosphatic and potassic fertilizers are applied, but as the nitrogenous compounds are very quickly dissolved and lost, they should be applied only for immediate effect. If but one application is to be made it should be given when the grass is commencing its growth in the spring. A mixture which has given satisfaction on grass lands containing lime is composed of equal weights of cotton-hull ashes and cotton-seed meal. For lands deficient in lime the same mixture may be used, and a separate application of acid phosphate added early in the spring. Cotton-seed meal produces little effect on the clovers, and for such crops a mixture of equal weights of ashes and land plaster is most effective, adding the separate application of acid phosphate when the soil is deficient in lime.

There is no machine which will distribute these fertilizers more evenly and economically than can be done by hand.

SOILING AND FODDER CROPS.

The soiling crops available are not numerous, although there are many grasses and legumes which might be used. Alfalfa is used more than any other one plant, and on favorable soils its yield is heavy and continues for a long time. In central Mississippi, Alabama, and Georgia it can be cut once in six weeks, from March until its growth is stopped by fall drought, while farther south its growth is more nearly continuous. Teosinte will outyield any other plant on the rich alluvial soils near the coast, but it is not ready for use before midsummer. Johnson grass is used extensively, while milo maize, Kafir corn, Jerusalem corn, and other sorghums yield repeated cuttings from August until killed by frost. In Florida, rice and Para grass are used largely for soiling. A considerable amount of forage, most of which is used on the farm, is made from oats, rice, corn fodder, and other annual crops. Corn fodder, made by stripping the leaves from the stalks as soon as the grain becomes hardened, is used very largely, and considerable amounts of it are sold in the country towns. The forage made in this way, when well cured, is of excellent quality, but so much work is necessary in gathering it that it can not be made profitably with hired labor. A large part of what is saved is gathered by laborers on shares, the share of the planter thus costing him nothing except the injury to the grain crop, which may amount to as much as 18 per cent of the grain when the fodder is stripped before the leaves have ceased their growth.¹

When oats are cut just after heading, they make hay of the finest quality, though if allowed to stand a few days too long but little of the straw will be eaten. As the crop is one which can be grown during the winter on ground from which corn or some other crop has been harvested, and is off the ground in time for planting in the spring, it is often the cheapest hay crop which can be grown.

Rice is grown for hay near the coast, and has about the same value as oats in the northern sections. Two successive hay crops are often grown on the same ground during the year, the yield of each crop being about the same as that of oats, averaging about one and a half tons per acre of each.

THE MORE IMPORTANT HAY AND PASTURE PLANTS.

GRASSES.

Barnyard grass (*Panicum crusgalli*).—This grass requires a rich and somewhat moist soil, its name, "barnyard" grass, indicating the locality which it prefers. It is coarse and succulent and is not easily cured into hay, but it is quite valuable for soiling and for the silo, as it yields heavily and produces an unusual amount of seed. When properly

¹ Bulletin No. 30, Mississippi Agricultural Experiment Station.

cured the forage is to be preferred to that of any other of the millets. In some sections of Mississippi and Florida it makes a good part of the volunteer growth which is used for hay. Dr. Phares, of Mississippi, says that "hundreds of acres are annually mowed, and farmers who have tested it thoroughly for many years prefer it to the best corn fodder." Several varieties of this are now in cultivation in this country; one of these, called "Japanese barnyard millet," promises to be of great value. "Ankee" grass, a native of the Southwest, is another promising sort. No reports of the value of these millets have been published from the Gulf States, but they have made such good yields in the North that they should be carefully tested there.

The seed is not as heavy as that of the broom corn or foxtail millets, weighing but 35 pounds per bushel, and may be sown at the rate of from one-fourth to one-half a bushel per acre for a crop of hay, and somewhat less for a crop of seed. As a rule drilling is preferable to sowing broadcast.

Bermuda grass (*Cynodon dactylon*).—Bermuda grass is to the South what Kentucky blue grass is to the North, and is the best hay and pasture grass for all soils which are not too wet. It is the most common grass in all parts of the Gulf States, and the vigor of its

growth is very good indication of the quality of the soil on which it is found. Its leaves and stems are so fine and its creeping stems lie so close to the ground that it makes an excellent lawn grass. Bermuda grass is never injured by protracted drought, and is unhurt by the most frequent grazings or cuttings. Its rootstocks are so strong and wiry that it is the best of soil-binders, and is used extensively for protecting levees and embankments. It is one of the best grasses for grazing and may well be used in the Gulf States as the foundation for all permanent



FIG. 1.—Bermuda grass (*Cynodon dactylon*).

pastures. As a hay grass it is unexcelled. In favorable seasons it will give two cuttings and on good soils its yield is from 2 to 4 tons of hay per acre.

Bermuda grass is usually propagated by transplanting the roots. This may be done at almost any time except during the coldest winter months, and the work is not more expensive than is the seeding of ground in the ordinary manner. Shave off sods an inch or two in thickness, cut them in pieces about an inch square, and drop on the ground about 2 feet apart each way, stepping on each one and crowding it into the soft ground as it is dropped. If it is necessary to do the work when the ground is too hard for this method, one man can make small holes with one stroke of the hoe, while another drops the sods and covers them with his foot. When the ground is in good condition and the sods convenient one man can plant an acre in a day.

If seed is used in propagating Bermuda grass the ground must be very carefully prepared, being harrowed as fine as possible. The seed should be sown in March, at the rate of about 6 pounds per acre and covered with a roller, though if sown just before a rain no covering will be needed. As the seeds are small they must not be covered deeply or they will fail to germinate. Being expensive and unreliable, seed is seldom used.

If the land is to be used for pasture only, the easiest means of securing a sod is to run shallow furrows, from 2 to 4 feet apart, into which sods are dropped every few feet and trampled into the soft soil. This method does very well for pastures, but leaves the ground too rough for mowing. So easily may Bermuda grass be propagated that good stands can be secured by scattering a dozen or more sods to the acre and then cultivating the land in corn or cotton two or three years, after which the grass will have become so well distributed that the field will need only to be plowed and harrowed once in three to five years. The yield is greatly increased, and the grass responds very quickly to an application of fertilizer, especially of stable manure.

After a meadow has been in this grass some years the sod becomes so matted with roots that the growth is lessened, and it should be plowed or cut with a disk harrow, in order to give the grass a fresh start. If plowed in the fall, after the last cutting has been made, the field should be sown with oats, vetches, or a mixture of the two. As the sod is very tough it should be thoroughly harrowed both before and after the seed is sown, and, if possible, finished with a roller, so as to leave the surface smooth for the mowing machine. The oat and vetch crop will make a heavy yield of very superior hay in May, and by October the Bermuda will fully occupy the ground and yield a heavy cutting. As the grass rarely matures seed in this country the manure made from feeding it may be used without danger of spreading the grass where it is not wanted. Red clover is often sown where the land is first set with Bermuda, and although it does not usually make a

heavy growth and becomes very scattering after the first two or three years, it very materially increases the yield of hay, which is superior in quality to either Bermuda or clover alone.

When once established it is somewhat difficult to eradicate, and this is occasionally an objection to its general cultivation. The best method of destroying it is to plow the ground immediately after the hay is cut, leaving it as rough as possible. Plow again in November and sow to oats, and when that crop is harvested plow again and sow thickly with cowpeas, which will smother the few plants which may have survived the oats and will leave the land in fine condition for any future crop. Ton for ton, Bermuda grass has a feeding value fully equal to that of the best timothy, and many horsemen prefer it to any other hay.

Big blue-stem (*Andropogon provincialis*).—This is one of the broom-sedges, which are among the characteristic grasses of the Gulf States, no less than forty species and varieties being found there. All have the same general character, yielding a great amount of grazing and hay of fair quality if cut early, but becoming dry, hard, and woody with the development of the flowering stems, and almost worthless in the late autumn. Under continued pasturing they give way to other grasses, and only two or three make their appearance again in fields which have been once cultivated. All are perennials, but are killed by the first plowing.

The big blue-stem is the most valuable species in the group and is used more largely for hay than any other. If cut when the flowering stems are not more than half grown it makes excellent hay; but, unfortunately, it reaches that stage at a time when most planters are crowded with work in the cotton fields, and hence is usually cut too late to make forage of the best quality. It has a large cluster of tender root-leaves, which cure on the plant and remain there during the winter, forming an important addition to the winter forage. While there are other grasses which are better worth cultivating, the spontaneous growth of this is valuable.

Carpet grass (*Paspalum compressum*).—This is apparently indigenous along the coast, and is slowly spreading northward, being now somewhat common in central Mississippi and Alabama. It is undoubtedly one of the best pasture grasses for sandy soils, and it will bear more hard trampling and close grazing than any other species. On heavy soils it is often crowded out by Bermuda and other species, but on light soils of even moderate fertility it will soon cover the ground, to the exclusion of all others. It is a grass which soon comes in when sandy soils are pastured closely and will choke out the broom-sedge and other less desirable sorts. It is easily destroyed by plowing and never becomes a weed. It rarely grows large enough to be cut for hay, though on the prairies of southwestern Louisiana, where it is known as "petit gazon," it reaches a height of 2 feet or more and covers a large part of the native meadows. The seed is rarely found

in the market, but the plant is easily propagated by mowing when the seed is ripe and scattering the hay over the field where the grass is wanted. Even if but few plants should appear the first year, the seeds will soon be spread by stock so as to cover the entire field. It bears heavy frost without injury, and so affords considerable grazing during the entire winter. It is often used as a lawn grass on soils too light and sandy for Bermuda, and is excellent for that purpose, though

its rather light color makes it less attractive than a grass having a richer green.



FIG. 2.—Carpet grass (*Paspalum compressum*): a, attachment of spikelets to rachis; b and c, spikelets; d, floret.

Colorado grass or Texas millet (*Panicum texanum*).—This has very much the same habit of growth as crab grass, but is larger and coarser. It prefers low, damp soils, and in suitable locations will make two or three cuttings in a season, the hay being of very good quality. Like crab grass, it reseeds the ground freely, and will often make a heavy volunteer crop after cultivated crops have been harvested, though it never becomes a troublesome weed. It is grown quite largely in some parts of Louisiana, and is regarded there as being the best of the annual grasses for a volunteer hay crop. In certain parts of Texas, particularly in the counties along the Colorado River, in the central part of the State, it comes up in fields after the removal of corn or other grain crops, and is highly valued for hay.

Crab grass (*Panicum sanguinale*).—The most common grass in cultivated ground, making its principal growth late in summer, after other crops have been harvested or laid by, and so furnishing a large amount of hay with no expense excepting that of harvesting. Although not often on the market, crab grass furnishes more forage for home use in the Gulf States than any other grass. When oats, melons, and other early crops have been harvested it will soon cover the ground, and by October will often make a yield of 2 tons per acre, while in the pine woods and coast regions it will make nearly or quite as much on land

from which corn has been harvested in August. Near the coast it is usually more or less mixed with Mexican clover, and on soils which are well fertilized the mixture will often give as much as 3 tons per acre of excellent hay. The objection to the hay is that, if allowed to become overripe before cutting, the seed shatters off badly and the stems become woody and tough. It is also rather difficult to cure, and must be allowed to dry several weeks before it can be baled with safety.

Foxtail millets.—The foxtail millets (*Chetochloa italica* and var. *germanica*) are by far the most important group of millets grown in this country, probably in the whole world. They delight in rich, warm, loamy soils, and will not thrive in soils that are poor and thin. This is particularly the case with the coarser varieties, like German millet. Common millet and Hungarian usually give better results under adverse conditions of soil and climate than the other varieties commonly grown in this country. The foxtail millets are strong, rapid growers, and draw nourishment largely from the surface soil. The great mass of strong, fibrous roots have a beneficial effect on the physical condition of the soil, particularly in the case of lands recently brought under the plow. In the South the foxtail millets are regarded as well adapted to the upland soils of the cotton regions, common millet being best for the light soils and German millet for low, heavy soils. The length of time required to reach maturity varies a great deal, according to the variety and the soil and climatic conditions, the commonly grown varieties ordinarily being ready to cut for hay in from fifty to eighty days from date of sowing, and maturing seed in from ten to fifteen or twenty days later. Under very favorable circumstances some of the varieties may be in condition to cut for forage within a month or six weeks from time of seeding.

Varieties.—Common millet was one of the first varieties to be introduced and to come into general cultivation in the United States, but there seems to be no record of the exact date of its introduction. At the present time it is the most widely cultivated of the foxtail millets in this country. It is the hardiest of the commonly grown varieties, enduring drought the best and giving best returns on poor soils. It is one of the earliest of the foxtail millets, and is the most constant in its characters.

German millet has been in general cultivation in the South since the early seventies, but was introduced into the United States many years earlier. It makes a heavy yield of forage under favorable conditions, but does not stand drought as well as the smaller varieties, such as Common millet and Hungarian. The hay is coarser and less highly valued than that from the smaller millets, but when the forage can be fed in the green state, this will be found to be an excellent variety to grow, on account of the heavy yield. It is the latest of the varieties commonly grown here, and is exceedingly variable in its appearance and habit of growth.

Some of the so-called Japanese millets now on the market belong to the German millet type, as, for example, "Breck's Japanese millet," which is scarcely distinguishable from the common southern German millet.

Golden Wonder millet shows undoubted relationship to German millet in its large head, coarse leaves, and robust, simple stems. In yield of seed it leads all the other varieties of foxtail millets. The forage is coarse, like that from German millet, and the yield heavy under favorable conditions, but Golden Wonder is even more susceptible to drought than German millet, and is therefore less generally grown than any other of the well-established varieties. At the present time it is most extensively cultivated in the States along the Upper Mississippi and Lower Missouri valleys.

Hungarian seems to have been first brought into the United States soon after the introduction of Common millet. At the present time it is more widely grown in the North than in the South. By most farmers it is placed next to Common millet as a hay crop, the quality being regarded as better than that of German millet. It does not resist drought as well as Common millet, but with favorable conditions of soil and moisture it will usually give a somewhat heavier yield. One reason why Hungarian has not found more favor with farmers generally is that it shows a greater tendency than other common varieties to persist in the soil when allowed to mature seed before harvesting.

Seeding.—When millet is handled as a primary crop, seeding is generally done during the latter part of May or early in June in the North, and of course correspondingly earlier in the South; or, if the moisture conditions are favorable, it may be delayed as late as August 1 in the latter region, the general rule being, however, to sow millet as soon as the corn is planted.

The seed may be sown broadcast or with a grain drill. Ordinarily, there is but little, if any, choice between the two methods when the crop is to be cut for hay, except that the drilled seed gives an even stand and a little less seed is required. For a crop of grain or for silage or ensilage, drilling will generally give better results.

The common practice is to sow from one-half to three-fourths of a bushel of seed per acre for a crop of hay and somewhat less for a crop of grain.

Harvesting.—Cutting foxtail millets for hay should never be delayed until the seed has begun to ripen, particularly if it is to be fed to horses. On the other hand, it is best not to cut too early, as the hay is liable to have a more or less laxative effect upon the animals eating it. However, it is better cut early than late. The hay may be safely cut any time during the period from complete "heading out" to full bloom. The tough, fibrous nature of the stems and the stiff beards on the heads of millet that has been allowed to approach too close to maturity detract much from the palatability of the hay, and, although something is gained from the seeds in the way of nutriment, enough is lost in pala-

tability and increased fiber to more than make up for it. Moreover, the earlier cut hay is a much safer food for all kinds of stock. Cutting for soiling or for the silo can be done a little later than for hay, but should take place before the seed has begun to ripen.

One of the best methods of curing the hay is to allow the grass to lie in the swath until partially dry, then gather into cocks and let stand until thoroughly cured, after the manner of curing alfalfa and clover. Hay cured in this way is of better quality than that allowed to lie in the swath exposed to the sun until dry.

Uses and feeding value.—Millet is fed principally as a hay and soiling crop. The forage ranks well with that of other grasses in the nutritive content, and its palatability is about that of the average for the coarser sorts. For digestibility, millet forage compares favorably with that from other coarse grasses.

Already widely grown as a hay crop, millets deserve more general use for soiling. They are particularly valuable for feeding to dairy cattle, young stock, and sheep. There are many sections of the country where this crop can be made to supplement the pastures in such a way as to allow a material increase in the number of stock that can be kept on the farm.

The use of millet as an element in annual pastures may well receive greater attention from farmers in sections where there is a general shortage of pasturage. Such varieties as Hungarian and Common millet, which "sprout from the root" well, are best to sow for pasturage. Sheep and calves may be pastured on this crop with excellent results. It would be well to mix some other crop, like field peas, with the millet, or to allow the animals to run on a field of clover, rape, or some such crop for a portion of the time.

On account of the heavy yield of forage and the good quality of the product, millets are excellent grasses for use in the silo. Frequently a good crop of millet can be raised under conditions which would not admit of growing corn for ensiling, and in such instances it becomes of especial value.

Guinea grass (*Panicum maximum*).—Probably an African species, but now well established in many sections of Florida and grown occasionally at other places near the Gulf coast, where it is valued highly for both hay and pasture. In regions suited to it, it grows very rapidly, and needs to be cut about once a month to prevent the stems from becoming too large and coarse. It makes good grazing and gives a constant and heavy yield for soiling. Seed ripens only in the extreme South, and it is usually propagated by means of pieces of the root-stocks, which grow readily when transplanted. The stems are killed to the ground by the first heavy frost, and if the ground freezes slightly the roots are killed also. It has sometimes been confounded with Johnson grass, but is much less hardy and is much coarser and less valuable as a hay plant. Also, it is less troublesome as a weed.

Johnson grass (*Andropogon halepensis*).—This grass has been in cultivation in this country since about 1830, and is now quite generally distributed through the Gulf States. It grows best on the rich and heavy lime soils of the black-prairie region and along the creek bottoms of the yellow-loam region, and is rarely seen in the pine-woods region near the coast. In localities where it grows well it is at the same time one of the most valuable hay grasses and the most troublesome and pestiferous weed. As a pasture grass it has but little value, as it begins its growth late in the season and the tops are killed by the first heavy frost in autumn. Its large and fleshy rootstocks are near the surface, and are so injured by trampling that the grass soon almost wholly disappears from the fields, though there is always enough left to restock the land when it is again brought under the plow. Its greatest value is as a hay grass, and for that purpose it can not be excelled. On land which is suited to its growth it will give at least three cuttings annually, and make a total yield of from three to five tons per acre. The hay is coarse and not attractive in appearance, but stock of all kinds eat it greedily, seeming to prefer it to any other hay. Liverymen who have used it state that it is the best hay they can find, but it is rarely fed in stables where there is a ready sale for the manure, for the seeds spread the grass wherever the manure may be used. But if the hay is cut, as it should be, before the heads appear, the manure from it can do no harm.

When cultivated for hay the roots form such a dense mat in three or four years that the yield is much lessened. The ground should then be plowed and thoroughly harrowed during the winter or early spring, after which the grass will make a growth as vigorous as ever. The yield of hay is largely increased by sowing sweet clover with it, as the latter makes its first growth so early in the spring as to afford an additional cutting, while its deep biennial roots serve to keep the soil in a much better chemical and mechanical condition.

The objections to the cultivation of Johnson grass are the rapidity with which it spreads to fields where it is not wanted, and the great difficulty in eradicating it when it has become established. It will soon almost disappear when fields are pastured, but the roots remain alive and will again take possession of the field as soon as it is plowed. Instances are known where fifteen and even twenty years of continuous pasturing have failed to produce any appreciable effect on the vitality of the roots. When there are only occasional small patches of it in a field they can be destroyed by hoeing and covering with salt to the depth of half an inch, but when it covers any considerable portion of a field the only practicable method of killing it is by weekly hoeings continued from early spring until late summer. On sandy soils it can be readily killed in this manner, but on heavy clay or black lands the work is more difficult and will require a longer time. In any case the fields should be watched constantly for plants which are almost

sure to make their appearance from seeds washed in from adjoining fields or dropped by birds, cattle, or passing teams. It is so difficult to eradicate that it is rarely advisable to sow it on clean land, but if it is already established on the land it is often better to encourage it than to fight it, as a heavy crop of good hay is more profitable than an ordinary crop of either corn or cotton.

Kafir corn.—Kafir corn is a native of South Africa, belonging to the group of nonsaccharine sorghums, and has come into prominence within the past fifteen years as a valuable forage plant for certain sections of the United States. It is a close-growing, leafy, more or less branched plant with very compactly flowered heads. Three varieties are at present in general cultivation, namely, red Kafir corn, white Kafir corn, and black-hulled white Kafir corn. These varieties differ chiefly in hardness and in the character of the seed and hulls or glumes. Red Kafir corn is perhaps the most widely cultivated of the three varieties and is especially characterized by its hardness, fruitfulness, and its small, roundish, red or light-brown seeds, which are only partially covered by the thin brown hulls. White Kafir corn is the least hardy of the three, and may be recognized by the white, somewhat flattened seeds and the rather large, conspicuous gray or greenish-white hulls. The black-hulled white variety combines the hardness and the larger size of the red Kafir corn with seed and hull characters almost intermediate between the two preceding varieties.

Kafir corn is especially valuable because of its ability to thrive on a great variety of soils and under conditions of drought that would be fatal to corn. The leaves are thicker and coarser than those of corn and do not dry out so readily. They are closer together and the whole plant is much more compact, and hence not so much exposed. Unlike corn, it is not necessarily fatally injured by its growth being checked by drought or hot winds, but readily revives with the coming of rain. The leaves remain green and fresh until after the grain ripens, so that it is possible to harvest a good crop of seed and also one of forage of good average quality. Under ordinary conditions about 6 pounds of seed will be sufficient to plant 1 acre of land. The preparation of the soil, methods of cultivation, and subsequent treatment should be essentially the same as that given to the common sorghums.

The seed of Kafir corn is of much the same composition as Indian corn, and may be substituted for it as stock food to good advantage, although not having quite as high food value. It is also used to a considerable extent as human food.

Kentucky blue grass (*Poa pratensis*).—This has not given the uniform success in the South which it has farther north, though in many places, especially in North Carolina, northern Georgia, and on the lime soils of northern Mississippi, it is of considerable value. On low ground, where the soil is dark-colored and contains an abundance of lime, and on "seepy" hillsides, we have seen a few pastures of this grass which

afforded good grazing in the late fall and winter months, but it is useless to sow it on the dry clay hills or in the sandy pine-woods region. In the South it remains almost dormant during the hot weather and its chief value is for mixing with Bermuda grass, lespedeza, and other summer-growing species. Seed should be sown in September, at the rate of 40 pounds per acre. It shows but little during the first year from seeding, but if the soil is suitable it continues to improve for many years.

Large water grass (*Paspalum dilatatum*).—A rather coarse native grass, which grows best on rich and rather damp soils. It spreads slowly from the roots, but seeds freely, and when once started will soon cover a field where the soil is suited to its growth. The stems are rather coarse for hay unless cut early, but produce a very large amount of long and broad leaves, which remain fresh and green during the entire winter. It withstands the longest droughts without injury, bears grazing well, starts its new growth early in the spring, and is one of the best pasture grasses. Its habit of growing in clumps is an objection to its use for hay, but it is an excellent variety for mixing with redtop, as it grows best on the same character of soil and largely increases the yield.

Orchard grass (*Dactylis glomerata*).—This is one of the most widely grown of the cultivated grasses, and in the Gulf States is one of the best for winter pastures, as it makes a good growth on wet and heavy clay soils with ordinary field treatment. It commences its growth with the first warm days of February, and if not pastured is ready to cut for hay in April; it will then afford excellent grazing until checked by the summer drought. With the first autumn rains it starts a new growth of leaves, making rich fall pasturage and remaining fresh and green throughout the winter. The hay made from it is of excellent quality, though its habit of growing in large clumps is against its use as a hay grass; but it bears grazing well and recovers quickly when cropped down. It does well when mixed with redtop or alsike clover, and succeeds better than almost any other grass in woodland pastures. Sandy soils are not suited to its growth, and it can not be recommended for light and thin lands. Seed should be sown in August or very early in the spring, at the rate of 30 to 40 pounds per acre.

Para grass (*Panicum molle*).—This has been introduced from the West Indies or South America, and, where the climate is not too cold in winter, will produce an immense amount of forage. It does not mature seed in this country, but the roots live through the winter, the new growth being ready to cut by June 1, and it will furnish good cuttings every six weeks from that time until the end of the season, although it should not be cut after October 1, in order that it may have time to produce a crop of leaves to serve as a winter protection to the roots. It is of considerable value near the coast, but is too tender for regions subject to severe frosts.

Redtop (*Agrostis alba*).—This grass is found in nearly all parts of the United States, and presents many forms by some regarded as distinct

species. Its greatest value in the Gulf States is as a pasture plant for damp soils. For this purpose the form having long underground root-stocks (*Agrostis stolonifera*) is the best, as it is least injured by trampling. It does best on a soil which is rich and moist, but will grow fairly well on a dry clay soil, although not on dry sand. It bears continued overflows without injury, even when covered by water two or three weeks, and on most soils is more persistent and productive than Kentucky blue grass.

It is one of the best grasses for winter and early spring grazing, and should be used on the damp places in every pasture. It makes a moderate yield of fair hay and is especially valuable for mixing with orchard grass, alsike clover, and other moisture-loving sorts. It makes but little show the first season after seeding, but becomes stronger and more dense with age, and holds its place well against other grasses and weeds. In seeding, one bushel per acre should be used, and to that it is well to add half a bushel of perennial rye grass, which will occupy the ground the first year, but will disappear as the redtop becomes stronger.

Rescue grass (*Bromus unioloides*).—This is apparently a native of the southwestern part of the United States, and was one of the first of the native grasses to be brought into cultivation. It is known

as Australian oats, Australian brome, Arctic grass, and Schrader's brome. Although usually an annual, repeated cuttings or persistent grazing will prevent seed bearing, and so enable the plant to live several years. It grows best on a rich, loamy soil, and in most localities should be treated as an annual, as it is soon crowded out by other grasses on land which has not recently been plowed. It seeds freely, and yields volunteer crops as far north as the District of Columbia. When sown on suitable soil in August or September it begins its



FIG. 3.—Rescue grass (*Bromus unioloides*).

growth with the first autumn rains, and in a favorable season will give good grazing in December, while in a dry and unfavorable season it may be worth but little before February or March. When at its best it will often give two good cuttings for hay. Should it be desired to grow it continuously on the same field, the land ought to be plowed after the seed has matured, and during the summer it may be used to grow a crop of cowpeas or of crab grass, which should be cut in September to permit the rescue grass to secure an early growth. Seed

should be sown in August or September at the rate of from 30 to 40 pounds per acre.

Rye grasses (*Lolium italicum* and *L. perenne*).—These are among the oldest cultivated grasses and are probably grown more widely than any others in Europe. They have been used largely in the Northern States, where they are often satisfactory, but in the South they have not done well except in a few especially favorable locations. They succeed best on a rich, moist, sandy soil containing a fair amount of lime, and on such soils are fairly permanent, but on dry, thin soils and heavy clays they soon disappear. They will cover the ground sooner and make a better sward in a few weeks after planting than most other grasses, and so are valuable where quick results are wanted and for covering the ground while other and more permanent

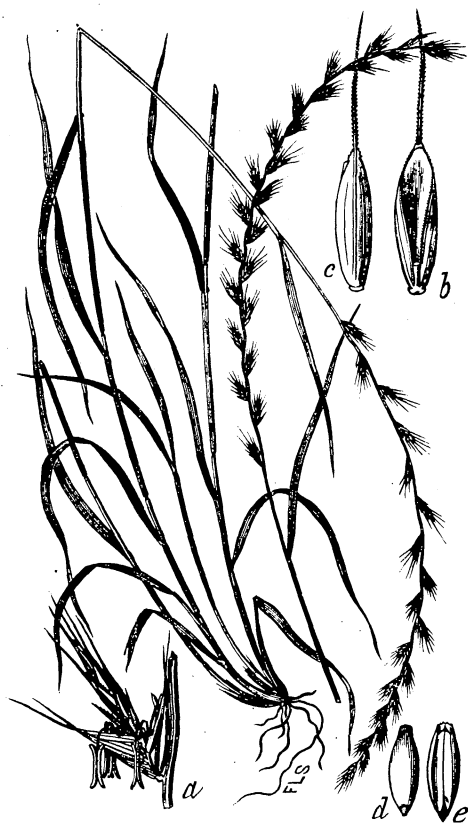


FIG. 4.—Italian rye grass (*Lolium italicum*).

sorts like redtop or orchard grass are becoming established. When sown alone on rich soils their growth is so rank that the ground is soon covered with a dense mat of long leaves, which make the best of grazing or hay, but if allowed to become too dense will die and decay after heavy rains. While excellent for mixing with other grasses for both pastures and meadows, they can not be recommended for sowing alone. The more common varieties are the Italian, Pacey's, and the perennial rye grasses. The perennial or English rye grass is the longer lived and so the best for permanent pastures. The Italian rye grass makes a ranker

growth and covers the ground more quickly. Seed may be sown in either fall or spring, and from 2 to 3 bushels per acre are required when sown alone or 1 bushel when sown with other grasses.

Smooth brome (*Bromus inermis*).—Although this grass has been popular in European pastures for more than a hundred years it does not appear to have attracted attention in the United States until about fifteen years ago, when it was highly recommended by the California experiment station. It was soon tested by many of the stations in other parts of the country, and nearly all of the earlier reports published were strongly in its favor. At all of the stations in the Gulf States it succeeded finely, and was thought to be of great value for winter pastures. It grows well in cool weather and bears drought. Cattle graze it with relish. In the South it is more valuable for pasture than for hay, and does better on dry than on wet soils. Although its growth on the trial plots was all that could be desired, its growth in the field has often been disappointing, and it is not gaining in general favor excepting in the Northwest. After eight years of experience with this grass on a great variety of soils it appears to be of doubtful value in the Gulf States. It has here some value for winter grazing on dry and loose soils; but its place can be better filled with other species.

Sorghum¹ (*Andropogon sorghum*).—There are comparatively few plants that will flourish under such widely different conditions of soil and climate as sorghum. The tendency to vary, which enables it to adapt itself so readily to different conditions of environment, has produced an almost endless number of varieties, differing chiefly in habit of growth, character of the seed, degree of sweetness, and length of season required in which to reach maturity. Sorghum is supposed to have come originally from equatorial Africa. At the present time some of its many varieties and forms are cultivated more or less extensively in all the warmer regions of the earth. In some countries, notably parts of Asia and Africa, it is one of the principal sources of the food supply for both man and beast.

Since its introduction into this country, some forty years ago, the cultivation of sorghum has spread very rapidly. At first it was grown almost entirely for the manufacture of sugar and molasses, but its value as a forage crop was soon recognized by many farmers, and for the past fifteen years or more it has been extensively grown for that purpose.

Varieties.—Although there have been so many varieties of sorghum introduced into cultivation, not more than ten or twelve of these are in general use at the present time. Those which give best returns in sugar and molasses are not always the best to grow for forage. For the latter purpose they should be hardy, rapid growing, not too coarse, quick maturing, well seeded with soft seed free from astringency, and they should stand up well. While a high sugar content is desirable, that quality is not so necessary as are the others named.

¹ Extract from Farmers' Bulletin No. 50.

Early or late varieties may be used, according to the time at which the forage will be most needed. As a general rule, the earlier varieties are the best for forage purposes. Seed may be planted at various times during the spring, and thus almost any desired succession of forage obtained.

The Amber canes, especially the earlier sorts, are the most widely used for forage purposes. They have a high sugar content, and come nearest to combining all the other qualities of a general-purpose cane. Next to these in value and extent of cultivation come the Orange varieties, especially those known as Early Orange and Kansas Orange. These are extensively grown in the South and Southwest, and are preferred by some to the Amber canes. The Orange canes are generally coarser growing and later than the Amber, and hence are less desirable for early feed or for hay, although as good or even better, perhaps, for late soiling or for the silo. Other varieties used more or less extensively for forage purposes are Folger's Early, Coleman, and Gooseneck. The first is said to be an excellent variety to use for summer pasturage.

Conditions of growth.—Sorghum, like corn, does best on rich sandy loams. It is a stronger feeder than corn, and gives better results on thin lands. It is maintained that when land has become too poor and thin to raise corn or small grain two or three good crops of sorghum may be obtained from it, and the land will be left in better condition for corn, cotton, and other surface-feeding crops. It is generally regarded as harder on land than corn, and this is undoubtedly true to a great extent, since it is a deeper feeder and two or more crops are often harvested in a single season. Still, there are many instances of sorghum being grown on the same field for many years without any apparent lessening of the quantity or quality of the crop from the impoverishing of the land, and there are many soils that are undoubtedly benefited by the deep-growing roots of the plant. When planted late, sown with cowpeas or field peas, and cut before the seeds ripen, the land is left in excellent condition, especially if it is plowed soon after the crop is taken off. Sorghum, like corn and other related plants, draws a large proportion of its food elements from the atmosphere. The principal materials taken from the soil are potash, phosphoric acid, and nitrogen. Comparatively little of the last substance is used.

A native of the tropics, sorghum naturally reaches its best development where high temperatures prevail. It is a standard crop in many places in the South where corn is grown in limited quantities. Both the saccharine and the nonsaccharine varieties of sorghum endure drought much better than corn, and hence are extensively grown in many of the drier regions of the country. In parts of the South and West, where severe droughts sometimes occur, sorghum is regarded as a sure crop, though corn and other grain and forage crops may fail to reach maturity. It will remain fresh and green through a dry spell

that would ruin corn. Even when drought has been so severe as to check its growth it will recover immediately on the renewal of the supply of moisture.

Methods of culture.—When sorghum is grown for forage and in ordinary farm rotations there is seldom need of much of an application of fertilizers. Many soils have been known to produce successive crops for eight or ten years without any apparent decrease in fertility. Well-rotted barnyard manure is perhaps the best fertilizer, should any be needed. The commercial sorts containing potash, phosphoric acid, and nitrogen may also be used, though as a rule but little of the last substance will be necessary. It is a common practice to use 150 to 200 pounds of cotton-seed meal per acre on land to be sown to this crop.

The best time for planting this crop for forage is about the middle of April. As a rule, the best forage is obtained by sowing the seed broadcast or with a press drill, such as is used in planting small grain. In the West and Southwest the latter method is to be preferred, as the cane stands up better and is not so likely to suffer from drought. On some soils better results are obtained by dropping or drilling the seed in rows far enough apart to allow an occasional stirring with cultivators.

Many farmers mix corn, millet, and various kinds of peas or beans with the sorghum, and in this way secure a better quality of forage. The sowing of legumes with sorghum is an excellent practice. The large amount of muscle-making substances in the legumes, together with the sugar and other fat-forming elements in the cane, affords a much more evenly balanced ration than either of the plants would make alone. Moreover, the legumes will do much to replace whatever nitrogen the sorghum may take from the soil.

Sorghum should always be sown much thicker when grown for forage than when it is to be used in the manufacture of sugar or molasses. The amount of seed needed per acre will vary somewhat according to the kind of forage desired, the method of planting to be followed, and the character of the soil. Under ordinary conditions $1\frac{1}{2}$ to 2 bushels (45 to 60 pounds) will be sufficient when sown broadcast, and a somewhat less amount will suffice when planted with the press drill. If the cane is intended for a summer pasture, a little more seed may be used. If peas or like crops are sown with sorghum, 3 pecks to 1 bushel of each will be ample. When planted in hills or drills for cultivation with hoe and plow, the seed should also be planted more thickly than when grown for the manufacture of sugar or molasses, otherwise the cane is likely to be too large to be easily handled, and stock will not eat it up clean. In many places in the South one seeding is sufficient for several years, as the cane sprouts up each season from the old stubble.

Cultivation.—If the cane has been sown broadcast or put in with a press drill and the ground is clean, very little cultivation is necessary. One of the advantages in using the press drill is that the field will

be in better condition for cultivation with the harrow should weeds become troublesome or the ground packed or baked. In such cases the sorghum may be given a light harrowing as soon as it becomes well established.

When sorghum is planted in hills or drilled in rows, it should be given about the same cultivation as corn. As a rule, however, the harrow may be used more and the plow and hoe less than with that crop. It is not necessary to thin out the cane when growing it for forage. Six or seven small stalks in a hill are of more value for this purpose than three or four large ones.

As soon as each crop has been harvested the field should be stirred with plow or harrow, and in this way the cane can be kept growing until frost stops it.

Much of the sorghum grown for forage is cut and fed green as a soiling crop. In moist climates there is often some difficulty in getting the cane properly cured. The stalks dry slowly and are liable to become sour and blackened if stored in large quantities. Under such circumstances sorghum which has been sown thickly may be cut with a mower or scythe and allowed to lie several days, when it may be put up into good-sized cocks and left until thoroughly cured. It may then be stacked in sheds or stored in the barn. That planted in rows may be cut with the corn knife or corn harvester and put up in small shocks or leaned up against poles supported on forked posts. It may be fed directly from the field or, when thoroughly dry, stacked or housed as desired.

When stacked outside it should be topped with rye or coarse grass. The practice of preserving sorghum in the "stack silo" is becoming more general each year.

When used for soiling, the cutting of sorghum may begin as soon as the "heads" are well formed, or even before if necessary, but it is at its best from the time of coming into bloom until the seed is about half ripe. Considering the quality of the forage and the ease with which it may be handled, as well as the quantity, the best time to cut this crop for either green or dry forage is when it is in bloom, or very soon afterwards. When more than one crop is to be harvested, it is the usual practice to cut the first one about the time the "heads" are well formed, but it may sometimes be necessary to cut sooner in order to give the second growth an opportunity to make sufficient development.

Value for forage.—Stockmen are unanimous in placing a high value upon sorghum for soiling purposes. It is not only an excellent forage for growing animals and those which are being prepared for market, but is one of the best feeds that can be used during the summer and early autumn for dairy cattle, on account of the large flow of excellent milk which it induces.

Sorghum forage compares very favorably with corn fodder, and while somewhat below corn in the muscle-making elements, it is richer in

the fat-forming ones, and hence is an excellent food for preparing animals for the market.

There is considerable prejudice in some sections against second-growth sorghum on account of its reputed injuriousness to stock. Most of the trouble seems to have arisen from carelessness in turning hungry animals into the fields and allowing them to gorge themselves. Stockmen agree that the same difficulty is met with in feeding clover or any other succulent forage, and may happen with either first or second or any other growth.

Southern canary grass (*Phalaris caroliniana*).—This grass has so much the appearance of timothy that it is often called "Southern timothy," though it is closely related to the true canary grass. It is widely distributed on damp soils along the coast from Louisiana to Florida, and is valued highly for winter and early spring grazing. Attempts to cultivate it for hay have not resulted successfully, as it fails to cover the ground well. Its chief value is as a pasture grass, and for that purpose it is well worth using as a part of the mixture for wet lands.

St. Augustine grass (*Stenotaphrum dimidiatum*).—This grass has a wide distribution, being found in the tropical and warmer temperate regions of both the Old and New World. In New South Wales it is known as buffalo grass, and in Jamaica it is called Pimento grass. It grows upon every variety of soil, from the apparently sterile sand dunes to heavy clays, but is rarely found far away from the coast. The flattened stems emit fibrous roots at every joint, where they also readily separate, each piece becoming a new center of growth. The leaves are flat or simply folded, blunt or obtuse at the apex, nearly one-fourth of an inch broad and 4 to 10 inches long. The flowering stems grow to the height of 6 inches to a foot or more. St. Augustine grass grows along our ocean shores as far north as South Carolina, and is extensively used for lawns in Charleston, S. C., and other cities in the South near the coast. It is useful for holding sloping embankments, especially those subject to wash. It is propagated by cuttings or sets, and quickly covers the most sandy yards with a dense carpet-like growth. In South America the creeping stems are employed in medicine as a diuretic. Other local names in this country are mission grass and Charleston lawn grass.

Tall fescue (*Festuca elatior*).—One of the popular introduced species, sometimes known as tall meadow fescue, English blue grass, Randall grass, and by other names. It succeeds best on rather moist, rich alluvial, or clay soils such as are commonly found along creek bottoms. It makes good hay, and as it remains fresh and green longer than most other grasses, it is quite valuable for permanent winter pastures. When grown for hay it should always be mixed with other grasses on account of its habit of forming large clumps when grown alone. Redtop and alsike clover will grow well on the same kinds of soil, and the three make an excellent mixture for either meadows or permanent pastures.

Tall oat grass (*Arrhenatherum elatius*).—Introduced from Europe, where it is one of the most valuable species for both hay and pasture. It is so highly prized in Europe that it has been planted repeatedly in all parts of the United States, and with widely varying results. In most cases it has been more successful in the North than in the South. It has been highly recommended for Tennessee, northern Alabama, Georgia, and North Carolina, but that seems to be about the southern limit of profitable cultivation. Farther south it is so weakened by the

long summers that after a few years it is crowded out by other species. It grows best on a light and rather dry loam, makes its best growth early in the season, and is easily cured for hay. It does not cover the ground well when sown alone, and for either hay or pasture should be mixed with orchard grass, perennial rye, red clover, or some other plant which will occupy the ground more fully.

Texas blue grass (*Poa arachnifera*).—This is emphatically a winter-growing species. In favorable location it begins its growth in October, and from November to May furnishes an abundance of luxuriant pasturage. It matures its seed in April and from the first of June until October makes but little growth. It is difficult to propagate by seed, but can be increased rapidly by means of the suckers which are produced in great numbers. A rich, loamy soil seems best suited to



FIG. 5.—Tall oat grass (*Arrhenatherum elatius*).

its growth, but in many places where the soil has appeared to be favorable its growth has been disappointing. Its only value is for winter pastures, although on good soils it is a fairly productive hay grass; it is more leafy and the leaves are longer than those of Kentucky blue grass. It has given good results at the experiment stations of Mississippi, Alabama, Georgia, and Florida, and in the grass garden on the Department grounds in Washington, D. C., but owing to the difficulty of propagation it has been very slow in coming into general cultivation.

Teosinte (*Euchlaena luxurians*).—This is the plant of which Prof. Asa Gray said: "Possibly affording an opportunity for one to make millions of blades of grass grow where none of any account grew before." At the experiment stations of Louisiana, Mississippi, Georgia, and Florida, it has given the heaviest yields of any of the forage crops grown, Georgia reporting 38,000 pounds of green forage per acre, Mississippi 44,000, and Louisiana the enormous amount of over 50 tons. It needs a long season of hot weather, a rich soil, and abundant moisture in order to succeed well, and it is useless to plant it where all these conditions can not be had. It is a remarkably vigorous grower, reaching 10 to 12 feet in height, with an unusually abundant supply of leaves and tender stems, which continue to grow until killed by frosts. If cut when it reaches 4 or 5 feet in height it makes excellent fodder, and will produce a second crop fully as large as the first. If left to grow until September or October it furnishes excellent material for the silo, in greater amount per acre than either corn or sorghum, and there are few plants which are its equal for soiling purposes. Its leaves are similar to those of sorghum, but much longer, and the stalks contain from 8 to 10 per cent of sugar. Its value for feeding and soiling is apparent from the fact that the entire crop of 50 tons per acre grown at the Louisiana station was sold to local dairymen at the rate of \$2 per ton while standing in the field. Its season of growth is so long that it seldom matures seed north of latitude 30°, but it has ripened well at the Louisiana and Florida stations. The seed, 1 to 3 pounds per acre, should be planted in hills 4 to 5 feet apart each way, about cotton-planting time, and the crop cultivated like corn. The greater distance should be given on the richer soils.



FIG. 6.—Texas blue grass (*Poa arachnifera*).



FIG. 7.—Teosinte (*Euchlœna luxurians*): *a*, one of the "ears" inclosed by the "husk"; *b*, the same with a portion of the husk removed, showing the grains; *c* and *d*, views of the grain.

LEGUMINOUS FORAGE PLANTS.

While the true grasses will always furnish the bulk of the hay crop and the greater part of the pastures, the cultivation of clovers, cow-peas, and other leguminous plants is an essential part of all successful farming, on account of the marked effect which they have in fertilizing and preparing the soil for future crops. The parts of the plants which are above the soil are valuable as food for stock, and those parts which are below the surface of the ground are often of equal value as food for future crops. This is especially true in the Southern States, where the subsoil is often very compact and impervious to water, and where the long-continued heat hastens nitrification and causes the rapid destruction and waste of vegetable matter in the soil. As all of the legumes are deep-rooting plants, they aid greatly in loosening the subsoil, and in consequence cause it to suffer less from excessive rains or from drought; they furnish a large amount of humus, and with a proper rotation of crops will furnish all the nitrogen, the most expensive element in fertilizers, that will be needed for other crops. Soils may be rested and greatly improved by the growing of true grasses, but the same effects can be secured more rapidly, economically, and profitably with leguminous crops, which at the same time will furnish better forage for all young or growing stock and milch animals.



FIG. 8.—Alfalfa; a, b, seed pod; c, seed.

There are but few of the legumes which will make permanent pastures or meadows, and for such fields the true grasses must be the main dependence, but in most cases the planter will find it more profitable to follow a rotation which will keep his land in forage crops only so long as may be necessary to prepare it for other crops, and for this two years is usually sufficient. While leguminous crops are restorative in the highest degree for a few years, their long-continued cultivation on the same ground finally renders the soil incapable of reproducing them profitably. A rotation of crops is universally recognized as being an essential to the highest success in farming, and this rule applies to

forage crops as well as to those cultivated with the plow and hoe. In the Southern States the planter has his choice among a large number of these restorative crops, which vary from three months to as many years in completing their growth, and some one of which will be found suited to almost every circumstance in which such a crop may be wanted.

Alfalfa, or lucern (*Medicago sativa*).—Alfalfa, or lucern, has been cultivated as a forage plant for more than twenty centuries. It is a native of the valleys of the central district of western Asia. It was carried from Spain into Mexico at the time of the Spanish invasion, and thence to the west coast of South America. It was brought from Chile to California in 1854, and from there it rapidly spread over the arid regions of the Pacific coast and Rocky Mountains, where it is now cultivated almost to the exclusion of other forage plants.

Soils and conditions of growth.—Alfalfa feeds most heavily on lime, potash, magnesium, and phosphoric acid. Lime seems to be the most essential to rapid growth, and there will not be a large or paying crop on soils lacking this fertilizer. The prime condition for success is that the land be well drained. If the subsoil is heavy and stiff and impervious to water, alfalfa will not be a permanent success, no matter how well the surface soil has been prepared.

Sowing the seed.—Farmers who have been successful with this crop agree, in the main, that the best stand and best yield follow an autumn sowing. The Southern farmer must fight continuously against the many weedy grasses that spring up in his fields and choke out the young cultivated plants if allowed to gain the upper hand. If an attempt is made to establish a field of alfalfa by sowing the seed broadcast in spring, crab grass and foxtail are on hand to choke out the seedlings before they can be fairly started, and it is only in exceptionally favorable years that a good stand can be obtained in this way. September and February are the two months which have been found best for the sowing of alfalfa. The seed should be drilled at the rate of 20 to 25 pounds per acre. The stand must be thick enough to enable the crop to hold its own against the weeds and weedy grasses which would otherwise take possession of the field.

As soon as the alfalfa is from 12 to 16 inches high the first crop can be mowed, and from that time it can be cut as often as it grows high enough. It is very important that the plants get a good footing and develop good root systems the first season. Alfalfa, when fully established, yields as much as 6, 8, 10, 12, and sometimes 16 tons of dry hay per acre per annum. A dressing of commercial fertilizers, compost, or cotton-seed meal will increase the yield of hay and green forage. Barnyard manure may be applied in the second autumn and in each year afterwards, because there will then be less danger of the alfalfa being choked out by weeds. It is better to apply this dressing in autumn or early winter than in the spring, on account of the weeds. The aver-

age life of alfalfa in the South has not been definitely determined. The meadow, however, will last just as long as the field can be kept clean. With good care the yield ought to be at least a ton per acre at each cutting, and four to eight cuttings each year.

Alfalfa hay.—There is no better hay plant than alfalfa. The making of hay requires considerable skill on account of the nature of the plant. If the hay is put into stacks or into barns before the stems are cured it is liable to heat and mold, and if it is allowed to lie on the ground too long before stacking the leaves get dry and brittle and will drop off, and a large share of the most valuable part of the forage will be lost. To make the best hay the field should be cut just when the first flowers commence to appear.

The art of making good alfalfa hay depends upon putting it in stack when it is just sufficiently cured to keep without heating, and is yet green enough to hold the leaves. This happy mean can be acquired only as the result of practice. The curing process may be materially hastened if a tedder is used before the hay is raked, especially if the growth is a very rank one. The value of the hay will depend upon its being well cured before the leaves have commenced to drop off.

Feeding value.—Alfalfa hay can be fed profitably to all kinds of farm stock. It is especially valuable for young and growing cattle and horses, and for sheep. It may be fed to working horses with the addition of a small grain ration, and they will keep in good condition upon it. If fed in combination with prairie hay, wheat straw, silage, or corn fodder, it makes a very nutritious forage.

Alsike clover (*Trifolium hybridum*).—Alsike is the best of the clovers for wet grounds, but is of no value on dry soils. On the borders of marshes, seepy hillsides, and places too wet for other clovers this makes its best growth. It seldom grows sufficiently large to make a good yield of hay, but is an excellent pasture plant, and should always be sown with redtop on the damp places in a permanent pasture. Sow 6 pounds of seed per acre in September or March.

Beggar weed (*Desmodium tortuosum*).—Beggar weed, or Florida beggar weed, is a leguminous plant with rather woody stalks from 3 to 8



FIG. 9.—Florida beggar weed (*Desmodium tortuosum*).

or 10 feet high, bearing an abundant leafage and, when in flower, much branched above. The seeds are borne in many-jointed, prickly pods, which break apart at maturity and are carried about by sticking to the bodies of animals or the clothing of persons. Florida beggar weed is a native of the West Indies and is closely related to the beggar weeds or beggar lice of northern woodlands or prairies. In the estimation of the Southern planter it ranks with velvet bean, though perhaps its sphere of usefulness is not so extended. It has been successfully grown in the grass garden on the grounds of the Department at Washington, D. C.

Beggar weed as a fertilizer.—Beggar weed, in common with all other leguminous plants, may be used as a nitrogen gatherer by the farmer, who is thus enabled to procure at small expense large quantities of this most valuable fertilizer or plant food. A crop of beggar weed turned under will, when decomposed, retain near the surface in easy reach of the roots of succeeding crops more of whatever fertilizers are subsequently applied. Besides adding a large amount of nitrogen to the soil the beggar weed takes up large quantities of lime and potash, about one-half of the total amount of ash consisting of these two elements. A 4-ton crop of beggar weed would, if turned under as green manure, supply an equivalent of half a ton of the best commercial fertilizer for the use of the succeeding crop in the rotation.

Seeding.—For a crop of seed, beggar weed should be sown at the rate of 5 or 6 pounds of clean seed per acre. If grown for hay, from 8 to 10 pounds should be used. It should not be sown until the ground is warm and moist, and the clean seed is preferable to the pods because of the more uniform germination and better stand which may be obtained. The seed is about the size, shape, and color of red clover and weighs about as much to the bushel. It is now on the market at a price low enough to place it within the reach of any farmer. If sown at the beginning of the summer rains the seed need not be covered. It must not be buried too deeply else the young plants will not be able to reach the surface. By sowing at the beginning of summer two crops may be secured. If cut for hay at the time the first flowers appear the roots will send up a second crop, which may be saved for seed, and enough seed will scatter to insure a crop the next season. The seed may also be scattered in the corn rows at the time of the last cultivation or at the beginning of the rains in June. Then, after the corn has been stripped or cut for fodder, the beggar weed may be mown for hay or harvested for seed. The crop should be cut for hay when it is about 3 or 4 feet high, or at the beginning of the blooming period. If cut after full bloom many of the lower leaves will have fallen and much of the best part of the crop will be lost.

Value for hay.—Beggar weed makes a fine quality of hay, which is relished by all classes of farm stock. It is preferable to velvet bean for hay on account of the ease with which it may be cut with the ordinary mower.

Compared with other forage plants.—Digestion experiments with beggar-weed forage have not been made, but judging from the comparison of the analyses with those of red clover, the nutritive ratio would be about the same. In the beggar weed the percentage of crude protein is less than in red clover, because there is a much larger amount of crude fiber, due to the larger and more woody stems. The percentage of loss in feeding beggar-weed hay is accordingly greater. On the other hand, the yield per acre is higher than that of red clover, ranging from 3 to 5 or even 6 tons per acre, especially when two crops are cut. Beggar weed is perhaps the best of the southern leguminous crops for the lighter, sterile, sandy soils, including the hammock and pine lands of Florida and the sandy pine lands along the Gulf coast.

Beggar-weed hay may be fed to best advantage by adding to the ration some coarse forage which contains a smaller amount of crude protein and more carbohydrates. In this way all of the digestible portion of the crude protein in the beggar weed may be utilized.

After the seed crop has been harvested beggar weed comes up again and the rowen supplies fine pasturage until killed by frosts. It never becomes a bad weed. The seeds do not sprout until the ground is warm, and it may be used as a rotation crop, following early spring vegetables or corn, the seeds remaining in the ground and making their appearance after these crops are out of the way.

Bird's-foot clover ; Yellow trefoil (*Lotus corniculatus*).—This grows well on light sterile soils, roots deeply, bears drought well, and is of considerable value as a pasture plant. It begins its growth very early in the spring, but is little esteemed after the beginning of summer. It is well worth sowing in dry pastures.

Bur-clover (*Medicago maculata* and *M. denticulata*).—Extensively introduced, and a valuable pasture plant for early grazing. Eaten well by cattle and sheep, and occasionally by horses and mules; of little value for hay. Seed should be sown in October, on rich loamy soil, and the plants will make good grazing by February or March. The seed matures in April and May, after which the ground may be plowed and cultivated in other crops during the summer. The clover seed will remain in the ground, and if the field is cleared of its summer crop by October no reseeding will be required. An excellent plant to mix with Bermuda grass.

Cowpea.¹—The cowpea has been cultivated in the South for at least one hundred and fifty years. It was probably first introduced on plantations in South Carolina, the seed having been brought from India or China. From this original introduction and from subsequent importations its cultivation has spread to almost every farm and plantation in the Southern States.

Cowpeas are, in their relationship and habit of growth, really beans and not peas, as the name would indicate. They are annuals and are closely related to the lablab, lima, and haricot beans of our gardens.

¹ Extract from Farmers' Bulletin No. 89.

Varieties.—Cowpeas occur in every gradation of habit, from a compact, stocky, upright bush having single stems a foot high with very short lateral branches to those with trailing runners growing as flat upon the ground as sweet-potato or melon vines, the prostrate stems 15



FIG. 10.—Leaf and pods of the cowpea (*Vigna catjang*).

to 20 feet in length. The pods vary from 4 to 16 inches in length, and the peas are of every imaginable shade of white, yellow, green, pink, gray, brown, red, purple, and black, of solid colors or variously mottled and speckled, and of varying sizes and forms, from large kidney-shaped

to little round ones smaller than the garden pea. There is a like variation in the length of time the different forms require to ripen seed, some requiring eight or nine months, a few ripening in sixty days from the time of planting.

The best varietal character is probably the color of the seed. The "red" and "black" varieties are closely allied; the round "lady" peas form a separate group; the large "black-eyed" and "purple-eyed" are typical of another, and the variously mottled and speckled "whip-poor-will" are only a degree removed from the solid-colored yellow, pinkish, and light-brown ones, and together would naturally be taken to constitute one species or variety. The black peas pass through various shades of red before maturity. The red varieties sometimes carry their change of color in ripening so far that they can not be distinguished from the black. The "black-eye" and "purple-eye" are of the same ground color, differing only in the color of the ring surrounding the eye. The various "crowders," yellow and white, the whip-poor-will, clay, and "yellow eye" forms have numerous crosses and so called hybrids in which the fundamental yellows and browns form varying mixtures.

Cowpeas and soil renovation.—A field of cowpeas has been very happily designated "the poor man's bank," for in common with all its leguminous congeners, the field pea, clovers, alfalfa, and a score of others, this crop increases the fertility of the soil upon which it grows.

Theoretically, to plow the vines under in autumn will be to save all the available nitrogen and convert the whole plant into humus. Practically, the turning under of so large an amount of watery green herbage is sometimes highly injurious, causing a too rapid decay and consequent "burning" or souring of the soil. The upper soil layers, freshly stirred and mellowed in autumn, lose more by leaching and washing than do those of an unplowed field covered by its winter mulch of decaying herbage, though in both cases there is a decided loss of fertility over what would result by following the peas with a crop of rye, winter wheat, the turf-forming winter oats, winter vetch, or crimson clover. The average soils of the South need more humus. It can be best supplied by sowing more grass, more permanent pasture lands, more leguminous crops. In a word, plant cowpeas.

Cowpeas for forage.—There is no forage plant better adapted to the needs and conditions of Southern agriculture than this rank, free-growing annual. It will thrive luxuriantly upon the rich, swampy, cane lands of Louisiana. On the driest and most sterile worn out uplands it serves the admirable purpose of supplying a larger quantity and better quality of forage than any other bean or clover; and whenever a crop of cowpeas has been taken off a field the surface soil is left richer by a good many pounds of that most costly of all plant foods, nitrogen. The roots of the cowpea enter deeply into the soil, opening and loosening it far down for the benefit of the roots of the succeeding

crops of corn, cotton, and tobacco. It has been found by experiment that the fertilizing value of the roots and stubble of the cowpea are very considerable, but not as great as that of the hay removed from the field. The best and most economical use of this forage crop is, then, to cut for hay, feed to stock, and return the stable manure to the soil. Plowing the whole crop under is less remunerative, because there is much needless waste of the muscle-making and fat-forming constituents of the plant, which would bring more profit if turned into beef, pork, wool, cheese, or butter.

Methods of cultivation and harvesting.—Cowpeas are planted broadcast or in drills, very commonly between the corn rows after the crop is laid by. The amount of seed used varies from 4 quarts to 2 bushels per acre, the average amount being, perhaps, about 3 pecks. If sown in drills, 18 to 30 inches apart, less seed is required than when sown broadcast. The seed will stand being covered to the depth of 2 or 3 inches, but care must be taken to plant when the ground is neither too wet nor too cold, as the peas rot very rapidly under such circumstances. Where the vines are grown for hay, the yield will be larger if the seed is planted in drills and cultivated a time or two. The yield of peas is also larger when only a moderate amount of seed is sown and the vines have more space and light and air between them. It is also heavier from late-planted vines than from the very early ones. In tests to determine the relative value of different named varieties it has been found that, as a rule, those which make the heaviest yields of vines also bear large crops of peas.

The vines should be mowed for hay when the peas are well formed and the leaves and pods are first beginning to turn yellow. After wilting on the ground or in windrows from twenty four to forty-eight hours, the hay is placed in small, thin piles, or cocks, and allowed to cure for several days, when it may be carted to the barn or stacked under sheds. The haymaking process is a difficult one, requiring more care and attention than in the case of red clover, because the broad leaves and thick stems contain a larger amount of water. The hay must be placed in cocks before the leaves become brittle, and the piles must be small enough to allow free circulation of air to the center of each. Bright cowpea hay, clean and well cured, is worth as much as the best red-clover hay.

Another method of curing hay is to stack the vines in a pen or rack of rails or poles so arranged as to allow the air to enter every part of the pile. This stacking over poles is best where the vines are pulled, or where the trailing or creeping sorts are used. The bush varieties are the best for hay, because of the greater ease with which they may be mowed or handled. They also hold their leaves better than the ranker trailing sorts.

In the Gulf States cowpeas will give an average yield of 2 to 3 tons per acre, while 4 to 6 tons are not uncommon. Farther north the

average will range from $1\frac{1}{2}$ tons in Ohio to $2\frac{1}{2}$ tons in Arkansas, Missouri, and Tennessee. North of the latitude of the Ohio River it is chiefly valuable as an addition to the list of drought-resistant, soiling crops and as a crop that will yield a considerable amount of forage on soil too sterile to grow red clover.

Harvesting the seed.—The majority of farmers harvest only enough seed of cowpeas to plant again the next season. The ripe pods are picked by hand and are stored in barrels until needed or are thrashed out by machine or with flails on the barn floor during the winter. Sometimes, if the crop is heavy enough to render it profitable, the vines are run through an ordinary thrashing machine from which the concaves and alternate teeth of the cylinder have been removed. But a machine breaks and bruises more of the seed than when the pods are first picked off by hand. Fully 95 per cent of the seed placed upon the market is hand picked. The yield per acre varies according to the variety and the method of cultivation. Eight to 12 bushels is a fair average of the amount that can be obtained when the peas are planted in the corn rows.

Feeding value of cowpeas.—The feeding value of cowpea hay is very high, as shown by feeding tests and chemical analyses. Berckmans states that the well-cured hay is more nutritious than any hay produced from grass, millet, or any other plant used for the purpose, and that one ton of it will last as long as a ton and a half of the best timothy. The average nutritive ratio of cowpea hay is 1:3.9; of alfalfa, 1:3.8; of crimson clover, 1:3.9; of red clover, 1:5.9; and of timothy, 1:16.2. The green cowpea vines are more succulent than red clover or any of the grasses, containing less dry matter per total weight.

When cowpeas are planted for green manure, it is an excellent practice to turn hogs into the field about the time that the first peas are ripening. Young pigs thrive amazingly on the succulent foliage and well-filled pods, and the quality of the pork raised on such a healthful and nutritious diet is very fine. This is a profitable method of fattening hogs or of preparing them for topping off with corn or sorghum for market. An acre of ripening cowpeas will pasture from fifteen to twenty hogs for several weeks, and the gain in fertility from the droppings of the animals during that period will more than counterbalance the fertilizing value of the forage eaten.

Crimson clover (*Trifolium incarnatum*).—Introduced from Europe; a valuable plant in nearly all of the country east of the Alleghany Mountains from New Jersey to Georgia, but it has rarely succeeded well in any of the Gulf States. Seed should be sown in September or October at the rate of 20 pounds per acre, and where it grows well it can be grazed during the winter or cut for hay in the spring before the seed begins to mature. The plant has not proved generally valuable west of the Alleghanies, and in the Gulf States has rarely made a crop of any value, as the plants usually die during early winter. The matured

plant is dangerous for feed, as the stiff hairs on the calyx form balls in the stomachs of animals and often cause death.

Japan clover (*Lespedeza striata*).—This may be classed among the most valuable leguminous hay and pasture plants of the Gulf States. It is a native of Japan, was introduced into this country about 1830, and is now thoroughly naturalized over the whole country south of the Ohio River. It grows on all soils, but does best on good loams containing a fair amount of lime. It will also grow on hard, dry clay, and even where the soil is quite sandy. On thin soils its growth is very flat and spreading, while on better soil it becomes erect, and is



FIG. 11.—Japan clover (*Lespedeza striata*).

often 2 feet in height. It endures heat and drought without injury, and stock eat it greedily. It never causes bloating, but occasionally has a slight salivating effect on horses, though that appears to occur in only a few localities. It starts late in the spring, but from May until after heavy frost it gives the best of grazing, and should be in every pasture. Although mostly used for grazing, it is a valuable hay plant, making a yield of from 1½ to 2 tons per acre. When wanted for hay it should be sown in early spring, at the rate of one-half bushel per acre, or it may be sown with oats in the fall, as it makes but little growth before the oats are harvested. For pastures it is necessary only to scarify the surface of the ground with a disk harrow, and it will often grow well without any previous preparation of the soil. There are a number of native species of *lespedeza* which are quite common in dry, open lands throughout the South, and although all are grazed, they are not worth cultivating.

Red clover (*Trifolium pratense*).—Red clover is becoming more popular each year, and is now quite a common crop in the black prairie region and in other sections where the soils contain a fair amount of lime. It requires a soil which is rich and in fairly good condition to insure a "catch" of the seed. On many soils where it makes a good start and yields two or three cuttings it soon becomes overrun with other plants and is choked out. It is the best of the family to occupy a good soil two or three years, but is of little value on poor soils. Seed should be sown in September at the rate of 10 to 12 pounds per acre, and it will then give a heavy cutting the following May. It succeeds best in the South when sown with no nurse crop.

Red clover grows well on rich lime soils which are in good condition, but needs to be managed somewhat differently from the method followed in the Northern States. In the South it should be sown in the fall, as soon as possible after the first of September. When sown at that time on well prepared and finely pulverized soil, the land being rolled to compact the surface soil and prevent it from drying too deeply, the seed seldom fails to germinate and to make sufficient growth to become well established before cold weather. The crab grass and weeds which

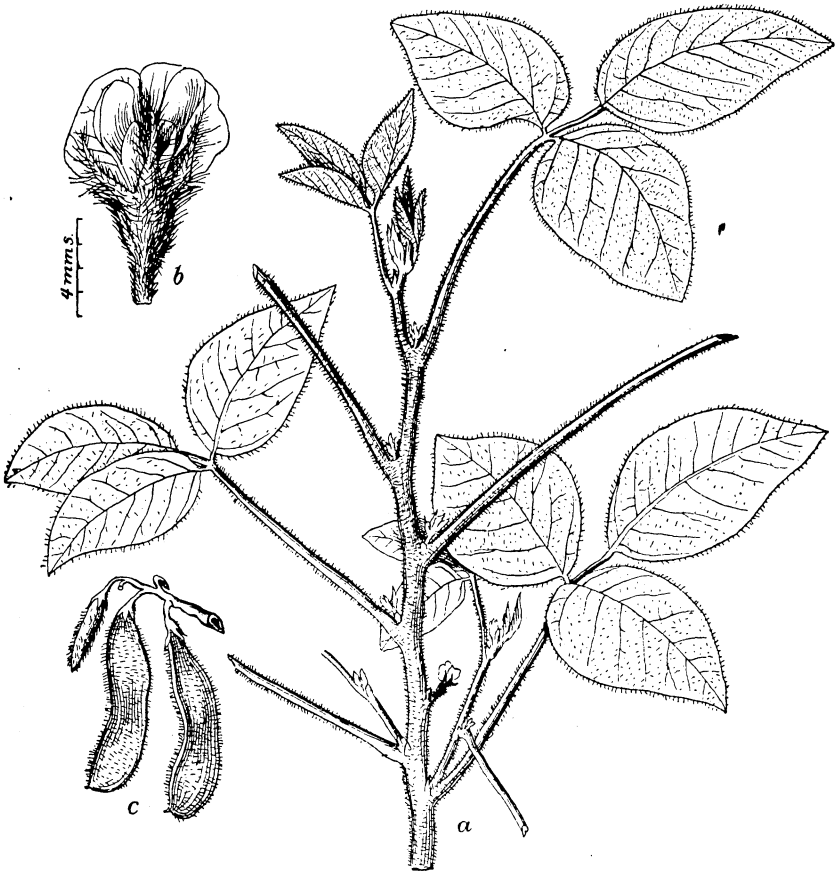


FIG. 12.—Soy bean, showing leaves, flower, and pods.

come up with it are killed by the first heavy frost, and when the warm days of spring come, the clover grows so rapidly as to keep down the weeds. On good soil it will make from 2 to 2½ tons of hay in May, with another lighter crop of hay or a good crop of seed in July. In favorable seasons it will make a third cutting, after which it usually begins to fail, and the ground should then be plowed for late corn. It is undoubtedly the best of the clover family for rich soils which are in good condition, but it is useless to sow it on barren fields or on rough

and poorly prepared lands of any kind. It has not been satisfactory on either sandy or white lime lands.

Soy bean (*Glycine hispida*).—One of the staple crops of Japan, which attracted little attention in this country until about ten years ago, but is now becoming quite common. The crop is cultivated like corn, the seed being planted in drills at the rate of half a bushel per acre. The stems alone are too coarse to make good hay, but are covered with such a dense growth of leaves and are so prolific in fruit that the hay is prized highly, especially for milch cows and for fattening animals. The yield of green forage is very heavy when grown on good soil, and the yield of beans is usually from 20 to 30 bushels per acre. Those who have had most experience with this crop find that the best way to handle it is to cut or pull the plants when the first pods begin to open, and thrash as soon as dry enough. In this way the coarse stalks are so broken in pieces and mixed with the leaves and immature fruit that nearly all will be eaten. It is doubtless the best of the legumes for the silo, as it can be more easily handled for the cutter than plants like clover or cowpeas. There are a number of varieties, differing mainly in the time of ripening and the color of the seeds.

Sulla (*Hedysarum coronarium*).—A very deep-rooting plant which grows best on a well-drained soil. It makes a heavy yield in early spring, but is so tender that it can not be recommended except in Florida, as the plants are killed by frosts.

“When sown in the fall it makes an enormous growth during the winter, which is slightly injured by very severe frosts without being killed. Scarcely hardy enough for a winter crop, and yet not successful as a summer one.”

Sweet clover (*Melilotus alba*).—Common where the soil is rich in lime. Even on the white rotten limestone hills in the black prairie region, where no other plants can grow, this makes a good yield. Its growth is much like that of a coarse alfalfa, but it will grow well on a much poorer soil and on one which is in poor mechanical condition, provided it has an abundance of lime. It may be sown with Johnson grass, as it will make one cutting before the grass has made much growth, and the later cuttings are heavier than when either plant is grown alone. It is an excellent pasture plant, beginning its growth in early spring. Cattle not accustomed to it do not always eat it readily at first, but if turned into the pastures before other vegetation furnishes much grazing they soon acquire a taste for it. The roots are very large and deep, and as they decay at the end of the second season, they are fine fertilizers. Seed may be sown in either October or February. Usually but one cutting of hay can be made the first year, but the second season it will make three good cuttings. Although a biennial, a few plants will produce seed the first year and a few will live three years, so that land needs to be seeded but once to secure continuous occupancy by melilotus.

White clover (*Trifolium repens*).—Uncertain and unreliable in its

growth, sometimes covering the ground with a thick mat of vigorous plants and then often disappearing for several seasons. It is a good grazing plant for cattle and sheep, but thought by some to be injurious to horses and mules.

Yellow lupine (*Lupinus luteus*).—This plant, unlike most other legumes, grows best on a soil containing but little lime, and so is especially valuable for the soils along the coast and for much of the pine-woods region. It affords good grazing, and the hay is valued as fully equal to that from red clover. The seed is high priced, and as from 75 to 100 pounds are required per acre, the plant is not yet common, but is well



FIG. 13.—Velvet bean, showing leaves, flowers, and young pods.

worth planting experimentally on soils poor in lime. In Europe it is used successfully for renovating worn-out sandy soils.

Velvet bean (*Mucuna utilis*).—Velvet bean has attracted a great deal of attention in the Southern States within the past three or four years. The uniformly favorable reports regarding its value in the South may be taken as an indication of the remarkable interest shown by farmers throughout the land in the more extended cultivation of leguminous crops. Everyone knows that the legumes, including such plants as the clovers, alfalfa, beggar weed, cowpeas, and velvet bean, are capable of enriching the land on which they are grown, because of

their ability to absorb nitrogen from the air, while other crops, such as the cereals, grasses, sorghum, and sugar cane, must have nitrogen provided for them.

Velvet bean is a native of India and has been in cultivation as an ornamental garden plant for many years. The Department of Agriculture introduced it into this country for this purpose about twenty-five or thirty years ago. In favorable localities it often forms vines 30 to 50 feet in length. It is an excellent plant for quickly covering unsightly objects or arbors. The purple flowers are borne in clusters, at intervals of 2 or 3 feet, at the joints of the stem. These are followed by clusters of short, cylindrical pods, covered with a black, velvety down, which has given the name to the plant. Each pod contains 3 to 6 large, rounded, brown and white mottled seeds. The pods are constricted laterally between the seeds, and are often more or less curved.

The value of the velvet bean as a forage plant was accidentally discovered about six or eight years ago. Being a native of the tropics, it only matures seed in Florida and the lower half of the States immediately along the Gulf coast.

Seeding.—In Florida the seed is sown in drills 4 feet apart, dropping from two to four seeds in hills 2 feet apart in the row. The crop should be cultivated several times. In orange groves and orchards the beans may be sown in drills 4 or 5 feet apart and not less than 5 feet away from the trees in order to keep the vines out of them. Farther north the seeds should be sown thicker in drills 2 or 3 feet apart, or broadcast at the rate of 1 or 2 bushels per acre. Its range of profitable cultivation does not extend beyond that of cotton.

Velvet bean makes its best growth on the lighter, sandy soils. While capable of increasing the amount of nitrogen, it requires a liberal dressing of phosphoric acid and potash in the form of superphosphates and muriate or sulphate of potash. It pays to feed the crop well because on rich ground the gain of nitrogen through the increased crop of vines is more than proportionate to the added cost of the potash and phosphoric acid.

The yields of hay are about the same as for the best varieties of cowpeas on similar soils. The plant grows looser and bulkier and looks as though it would yield twice as much hay as the cowpeas, but experiments conducted at the Alabama experiment station prove that the superiority in this regard is only apparent. The reported yields range from 2 to 4 tons per acre, or more in Florida, where two or three cuttings are made during one season. Farther north the crop has not the same recuperative ability and can only be cut once. The yields of seed amount to from 20 to 25 or 28 bushels per acre, about the same as for the most prolific varieties of cowpeas.

Feeding value.—The beans have a high feeding value, as shown by analyses made by the Florida experiment station. Digestion experi-

ments have not been made either with the hay or seeds. Judging from the chemical analyses, they are about equal in feeding value to cowpeas, but are of less value than either peanuts or soy beans.

A crop of velvet bean is harder to plow under than one of cowpeas, on account of the tangled mass of vines. It is necessary to use a rolling cutter, unless the farmer has a disk plow. At the Alabama experiment station it was found that as good results were obtained from plowing under the stubble as from plowing under a full crop of vines. As a general rule, it may be considered a wasteful practice to turn under the crop, because the feeding value of any leguminous crop is always greater than its fertilizing value.

Use of the beans for food.—The seeds are large, difficult to thrash, and the pod does not break up readily. Special machines have been constructed for the purpose of cleaning them. For feeding purposes it is a good idea to grind them up, pods and all, thus saving the expense of thrashing. The meal may be used as a concentrated feeding stuff in the same manner as cotton-seed meal. It is said that cattle, sheep, hogs, and poultry are all very fond of them, but horses apparently do not relish them.

Hairy vetch, or sand vetch (*Vicia villosa*).—This annual leguminous plant is a native of western Asia. It has been cultivated for about fifty years in some parts of Europe, especially southern Russia, Germany, and France, and was introduced into this country for the first time about 1847 under the name of Siberian vetch. Excellent reports as to its drought-resisting qualities and its adaptability to our climate have been received from Washington, Nebraska, Georgia, New Mexico, South Dakota, Minnesota, Montana, and Pennsylvania. It has been grown on the experimental grounds of the Department of Agriculture at Washington, D. C., and has proved to be thoroughly adapted to and valuable for this locality. The seeds germinate poorly when they are more than two years old. Most of the seed used in this country is imported from Europe, so that particular care ought to be taken by importers and dealers to handle none but such as can be sold under guaranty as good, fresh seed.

At the Mississippi Agricultural Experiment Station seed of this vetch was sown in October, 1888, and since that time has given heavy annual crops on the same ground, although receiving no attention. Its seeds germinated with the first autumn rains and covered the ground by the first of January, furnishing good grazing until April or May. If the stock is taken off the field in March the plants will mature and reseed the ground freely for the next year.

Cultivation.—Hairy vetch may be sown in autumn, from about the middle of August to the middle of September; or in spring, from the latter part of April to the middle of May. It should be sown broadcast or with a grain drill at the rate of 1 to 1½ bushels of seed per acre. The latter method will require a less amount of seed. When the seed

is put in broadcast, a bushel of rye, oats, or wheat should be sown at the same time, so as to furnish a support to keep the vines up off the ground. If it is sown in drills in the latter part of August, the crop should be cultivated several times. It will furnish some forage in autumn, and where the winter is not too severe will start to grow again in the spring, thus producing forage in late autumn and early spring, at the two periods when it is most needed.



FIG. 14.—Hairy vetch (*Vicia villosa*).

Winter vetch (*Lathyrus hirsutus*).—Winter vetches were introduced into the United States from Italy, where they are grown quite extensively as a winter soiling crop. They are of value only in the Southern States and have not been found hardy anywhere north of the latitude of Washington, D. C.

Winter vetches are very similar in habit and manner of growth to

the spring vetches or tares. They are trailing, vine-like plants that grow in dense masses. The stems are narrowly wing-margined; the narrow leaflets are in pairs with a tendril arising between them; the inch-long pods are quite hairy; and the rounded, dark-brownish seeds appear warty under a lens.

Winter vetches for the South.—Winter vetches should be sown broadcast in August or September at the rate of two bushels of vetch and one bushel of winter rye or winter oats per acre. If sown in the latter part of August they furnish a bite of green forage in November and December, at a time when it is particularly desirable, and can be cut for hay in the early spring. If sown in February in the Gulf States they provide a supply of green forage in April or May. The plant is valuable both as a soiling and hay crop, and deserves to be more widely cultivated. It makes its best growth in spring and autumn, when the weather is cool. Winter vetch thrives on any soil which will grow cowpeas, provided that it is not too wet. Its cultivation has been very successful in all portions of the South where it has been tried, and particularly so in central Georgia and Alabama. The winter vetch is desirable as an addition to our list of forage plants, because it lengthens out the soiling season, and furnishes green forage late in autumn and very early in spring, during two periods of scanty vegetation. Winter vetch should be cut for hay when in full bloom. Considerable care is required to get it into the stack or barn without its heating. Anyone who can make good cowpea or alfalfa hay can successfully handle winter vetch.

MISCELLANEOUS FORAGE PLANTS.

Artichoke (*Helianthus tuberosus*).—One of the best and most profitable crops for winter hog pastures. The tubers may be cut in small pieces for planting, as is done with Irish potatoes, and about the same amount of "seed" per acre is required. They are planted in the same manner and require the same cultivation as the Irish potato. The tubers make very little growth before October, and do not become thoroughly matured before December. The yield is larger than that of any other root crop, being ordinarily from 400 to 600 bushels per acre, while double those yields are secured under specially good conditions. When the crop is fully matured a few rows should be plowed out to secure "seed" for spring planting, and this should be buried like potatoes. When the field is turned over to the hogs enough of the tubers will be left in the ground to restock the field, but as the hogs will leave the ground very rough and uneven, and the plants will be so irregular that they can not be cultivated, it is much better to plow the entire field in the spring and replant in regular rows. When it is desired to clear a field in which artichokes have been grown it can be accomplished by a single plowing in June or July, after the new growth has exhausted the old tubers and before the new crop has formed.

Cassava (*Manihot aipi*).—A native of the tropics, but recently introduced in Louisiana and Florida. On fertile soil it is said to yield as much as 10 tons of roots per acre, and the roots are worth fully as much as potatoes for feeding. The plant is propagated by planting short cuttings of the stems, and requires only ordinary cultivation. As the roots decay quickly after being taken out of the ground, they should be dug only as wanted for use.

Chinese yam (*Dioscorea batatas*).—The roots are quite large, club-shaped, often reaching 3 feet in length with a diameter of 3 inches at the lower end. They are starchy and mucilaginous, and make a food fully as rich as sweet potatoes, but their peculiar shape makes them hard to dig. The plant is propagated by means of small tubers which are produced in immense numbers in the axils of the leaves, and on a rich loamy soil the yield of these tubers is often 50 or more bushels per acre. These tubers remain on the surface of the ground uninjured during ordinary winters, and so are a valuable winter food for hogs.

Chufa (*Cyperus esculentus*).—A perennial sedge that produces a large yield of small tubers which are a valuable food for hogs. It grows best on a well fertilized sandy soil where it makes a yield of from 75 to 100 bushels per acre. The tubers are planted in early spring, 12 to 15 inches apart in rows 3 to 4 feet apart, and the only cultivation needed is to keep down grass and weeds. The tubers mature in October and November, and are easily rooted out by the hogs. This plant is of little value on heavy soils.

Mexican clover (*Richardsonia scabra*).—This is not a true clover, but takes its name from its habit of growth, which is much like that of red clover. It is a native of Mexico and Central America, but has become thoroughly naturalized along the Gulf coast, and is found occasionally as far north as central Mississippi and Georgia. A sandy soil seems essential to its vigorous growth in cultivated fields after other crops have been laid by. Where this and crab grass grow together on well-fertilized soils the yield of hay is often two tons per acre, and costs nothing but the cutting. Feeders are somewhat divided as to its value, some claiming that it makes hay of fine quality, while others declare it to be worthless. (Chemical analysis of the hay indicates that it is nearly or quite as rich a food as red clover, and it is certain that many animals keep in good condition through the winter with no other feed. It has but little value for grazing.

Peanut (*Arachis hypogea*).—Of some value for hay, and cultivated for hog pastures in all parts of the South. There are two very distinct types in cultivation, the "common" and the "Spanish." The former is the one which produces the peanut of commerce. The plant grows as straggling as a potato, and the nuts are produced on long peduncles and often quite scattered. It is seldom used for hay, though often grown for hogs. The Spanish variety is a smaller, more compact, and erect plant, which produces an immense number of very small nuts clustered closely at its base. This variety is growing in favor for hay,

as the plant, with its closely adhering nuts, is easily pulled up. The yield is from 1 to 2 tons per acre, and as nearly half the weight is in the nuts, the hay is richer in protein than any other in common use. Either variety makes fine fall pasturage for hogs, and as the hogs do the harvesting, peanuts furnish the cheapest food for the season.

ADAPTATION OF FORAGE PLANTS TO SOILS.

With reference to the selection of forage plants adapted to different regions, the soils of the South Atlantic and Gulf States may be classified as follows:

(1) Yellow loam soils; (2) alluvial and river bottom soils; (3) black prairie soils; (4) pine woods soils.

The forage plants most successfully grown for different purposes on these soils are enumerated below:

Forage plants for yellow loam soils.—For permanent meadows on rich land, Bermuda grass; for a hay crop to occupy rich land two years, red clover; for a single hay crop on fair soils, cowpeas; on poor soils, lespedeza. For permanent pastures, Bermuda grass and lespedeza, to which may be added on dry soils, orchard grass, smooth brome grass, and bur clover; on wet soils the addition should consist of redtop, water grass, and alsike clover. Crimson clover, rescue grass, Terrell grass, and hairy vetch are recommended for winter pasture.

Forage plants for the alluvial and river bottom soils.—For permanent meadows, Bermuda grass and red clover; on wet spots, redtop; and on well drained soils, alfalfa. For a hay crop for a single season, lespedeza or German millet. For pastures, Bermuda grass, lespedeza, redtop, alsike clover, bur clover, alfalfa, Japanese rye grass, large water grass, and Terrell grass.

Forage plants for the black prairie soils.—For hay, Bermuda grass, red clover, and sweet clover. For a hay crop for a single season, lespedeza. For a catch crop, following oats, potatoes, etc., cowpeas or German millet. For pastures, Bermuda grass, lespedeza, sweet clover, alsike clover, smooth brome grass, orchard grass, redtop, bur clover, and hairy vetch.

Forage plants for the pine woods soils.—For hay, Bermuda grass, crab grass, Mexican clover, alfalfa, crimson clover, and lespedeza. For pastures, crimson clover, Japanese rye grass, orchard grass, carpet grass, and large water grass.

It must be remembered that variations in local conditions of soil and climate make it necessary to exercise great care in the selection of forage plants for particular purposes. The more complete statements of the conditions under which different species have proved successful, given in the body of this bulletin, should be considered in detail before definite conclusions are drawn regarding the value of particular plants for any locality.

FARMERS' BULLETINS.

These bulletins are sent free of charge to any address upon application to the Secretary of Agriculture, Washington, D. C. Only the following are available for distribution:

No. 16. Leguminous Plants for Green Manuring and for Feeding. Pp. 24. No. 19. Important Insecticides: Directions for Their Preparation and Use. Pp. 32. No. 21. Barnyard Manure. Pp. 32. No. 22. Feeding Farm Animals. Pp. 32. No. 23. Foods: Nutritive Value and Cost. Pp. 32. No. 24. Hog Cholera and Swine Plague. Pp. 16. No. 25. Peanuts: Culture and Uses. Pp. 24. No. 26. Sweet Potatoes: Culture and Uses. Pp. 30. No. 27. Flax for Seed and Fiber. Pp. 16. No. 28. Weeds; and How to Kill Them. Pp. 30. No. 29. Souring of Milk, and Other Changes in Milk Products. Pp. 23. No. 30. Grape Diseases on the Pacific Coast. Pp. 16. No. 31. Alfalfa, or Lucern. Pp. 24. No. 32. Silos and Silage. Pp. 31. No. 33. Peach Growing for Market. Pp. 24. No. 34. Meats: Composition and Cooking. Pp. 29. No. 35. Potato Culture. Pp. 23. No. 36. Cotton Seed and Its Products. Pp. 16. No. 37. Kafir Corn: Characteristics, Culture, and Uses. Pp. 12. No. 38. Spraying for Fruit Diseases. Pp. 12. No. 39. Onion Culture. Pp. 31. No. 40. Farm Drainage. Pp. 24. No. 41. Fowls: Care and Feeding. Pp. 24. No. 42. Facts About Milk. Pp. 29. No. 43. Sewage Disposal on the Farm. Pp. 20. No. 44. Commercial Fertilizers. Pp. 24. No. 45. Some Insects Injurious to Stored Grain. Pp. 24. No. 46. Irrigation in Humid Climates. Pp. 27. No. 47. Insects Affecting the Cotton Plant. Pp. 32. No. 48. The Manuring of Cotton. Pp. 16. No. 49. Sheep Feeding. Pp. 24. No. 50. Sorghum as a Forage Crop. Pp. 24. No. 51. Standard Varieties of Chickens. Pp. 48. No. 52. The Sugar Beet. Pp. 48. No. 53. How to Grow Mushrooms. Pp. 20. No. 54. Some Common Birds in Their Relation to Agriculture. Pp. 40. No. 55. The Dairy Herd: Its Formation and Management. Pp. 24. No. 56. Experiment Station Work—I. Pp. 30. No. 57. Butter Making on the Farm. Pp. 16. No. 58. The Soy Bean as a Forage Crop. Pp. 24. No. 59. Bee Keeping. Pp. 32. No. 60. Methods of Curing Tobacco. Pp. 16. No. 61. Asparagus Culture. Pp. 40. No. 62. Marketing Farm Produce. Pp. 28. No. 63. Care of Milk on the Farm. Pp. 40. No. 64. Ducks and Geese. Pp. 48. No. 65. Experiment Station Work—II. Pp. 32. No. 66. Meadows and Pastures. Pp. 24. No. 67. Forestry for Farmers. Pp. 48. No. 68. The Black Rot of the Cabbage. Pp. 22. No. 69. Experiment Station Work—III. Pp. 32. No. 70. The Principal Insect Enemies of the Grape. Pp. 24. No. 71. Some Essentials of Beef Production. Pp. 24. No. 72. Cattle Ranges of the Southwest. Pp. 32. No. 73. Experiment Station Work—IV. Pp. 32. No. 74. Milk as Food. Pp. 39. No. 75. The Grain Smuts. Pp. 20. No. 76. Tomato Growing. Pp. 30. No. 77. The Liming of Soils. Pp. 19. No. 78. Experiment Station Work—V. Pp. 32. No. 79. Experiment Station Work—VI. Pp. 28. No. 80. The Peach Twig-borer—an Important Enemy of Stone Fruits. Pp. 16. No. 81. Corn Culture in the South. Pp. 24. No. 82. The Culture of Tobacco. Pp. 23. No. 83. Tobacco Soils. Pp. 23. No. 84. Experiment Station Work—VII. Pp. 32. No. 85. Fish as Food. Pp. 30. No. 86. Thirty Poisonous Plants. Pp. 32. No. 87. Experiment Station Work—VIII. Pp. 32. No. 88. Alkali Lands. Pp. 23. No. 89. Cowpeas. Pp. 16. No. 90. The Manufacture of Sorghum Sirup. Pp. 32. No. 91. Potato Diseases and Their Treatment. Pp. 12. No. 92. Experiment Station Work—IX. Pp. 30. No. 93. Sugar as Food. Pp. 27. No. 94. The Vegetable Garden. Pp. 24. No. 95. Good Roads for Farmers. Pp. 47. No. 96. Raising Sheep for Mutton. Pp. 48. No. 97. Experiment Station Work—X. Pp. 34. No. 98. Suggestions to Southern Farmers. Pp. 48. No. 99. Common Insects on Shade Trees. Pp. 30. No. 100. Hog Raising in the South. Pp. 40. No. 101. Millets. Pp. 28.